NATIONAL RESEARCH UNIVERSITY

POLITECNICO MILANO 1863

DO MERGERS POLICIES INCREASE UNIVERSITIES' EFFICIENCY? EVIDENCE FROM REGRESSION DISCONTINUITY DESIGN

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OUTLINE

- Universities mergers in Russia
- Policy description
- Literature on mergers in HE sector
- Quasi-experimental evaluation of mergers' impact on university efficiency
- Discussion and concluding remarks

MERGERS IN RUSSIAN HE

1st wave

- Post-soviet transition during 1991-2000: mergers in order to overcome high specialization and respond to changing needs of the labor market

2nd wave

- Federal universities: mergers in order to modernize HE system and establish new, innovative universities

3rd wave

- Monitoring of performance: mergers in order to improve performance of universities

4th wave

- Flagship universities: mergers in order to improve higher education quality in Russian regions and increase universities' contribution to regional economic development

Romanenko and Lisytkin, 2018

MONITORING OF PERFORMANCE

Introduced in 2012 by Ministry of Science and Higher Education

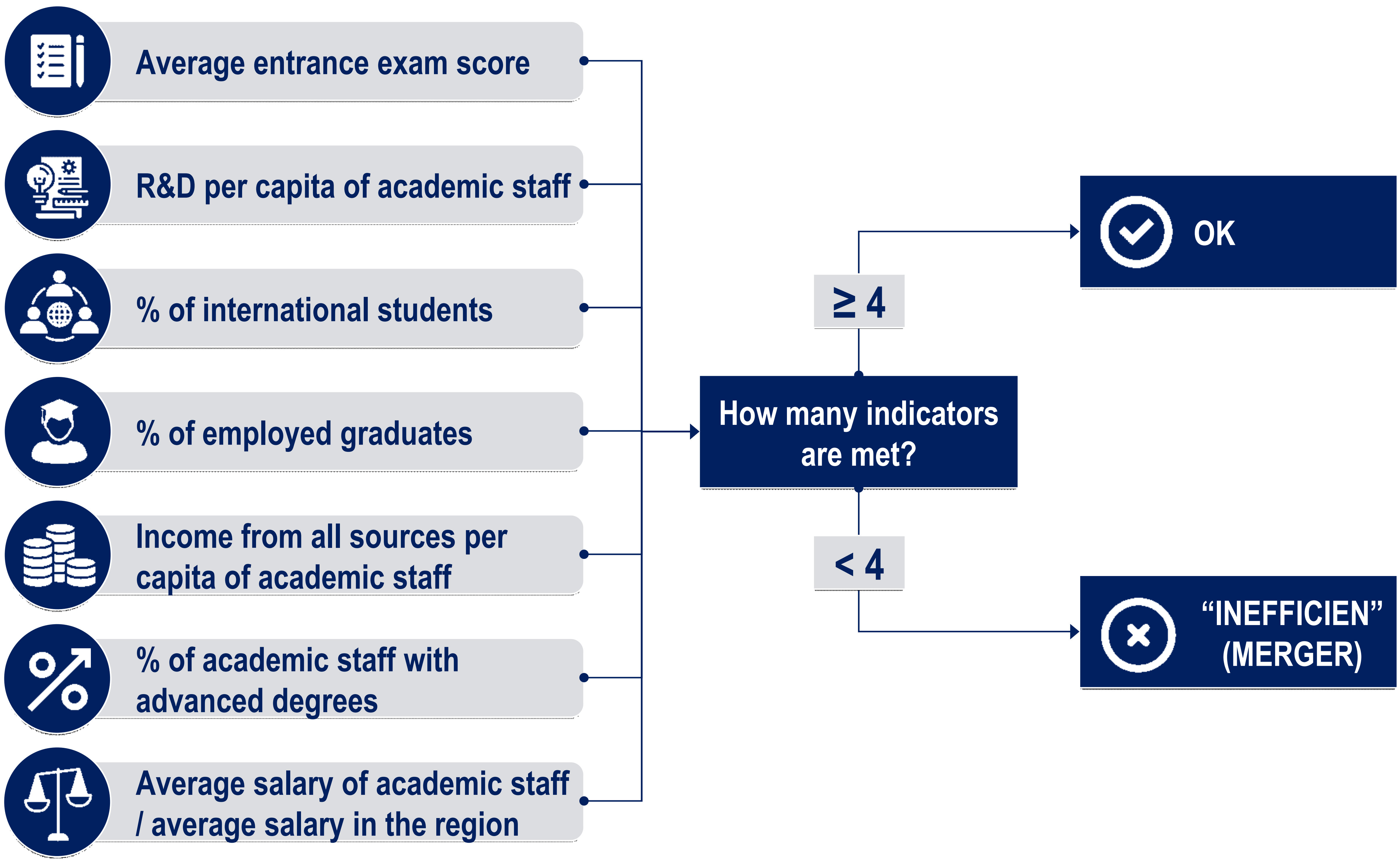
-Gather the data on performance indicator and define threshold values

-If particular university fails to overcame thresholds for at least 4 indicators out of 7, it receives “inefficient” from the Ministry

-”inefficient” university may be merged to stronger university

MERGER IS CONSIDERED IN CASE LESS THAN 4 PERFORMANCE INDICATORS ARE MET

Monitoring of performance as a basis for merger policy



LITERATURE ON MERGERS IN HE

Motivations for mergers activities

Rowley, 1997
Botha, 2001
Fazackerley, 2017

Short-run and long-run effects of merger policies on different sides of universities' activities

Valimaa et al., 2014
Wan, 2008

Factors affecting merger process

Harman, 2002;
Locke, 2007
Kyvik and Stensaker, 2013

Case-studies of universities mergers in different countries

Aagaard et al., 2016
Harman and Meek, 2002
Harman and Harman, 2003

MOTIVATIONS FOR MERGERS

Strategic mergers

-Mergers in order to improve positions in international ratings (Valimaa et al., 2014)

-Mergers in order to achieve national public policy aims (Wang, 2001)

-Mergers in order to expand growth capabilities (Johnes and Tsionas, 2018)

Economically motivated mergers

-Mergers in order to improve performance (Fielden and Markham, 1997)

-Mergers in order to reduce costs (Johnes and Tsionas, 2018)

-Mergers in order to improve efficiency (Johnes, 2018)

LITERATURE ON MERGERS IN HE

Mergers and efficiency of higher education institutions

China:

Hu and Liang, 2008; Mao et al., 2009: efficiency gains can be observed only in the first year after the merger

UK:

Johnes, 2014: Average efficiency is significantly higher among merged than either pre-merger or non-merging universities

Papadimitriou and Johnes, 2018: Merged universities on average demonstrate higher efficiency when controlling for observed heterogeneity – subject mix, source of income, size. The strongest effect of merger on efficiency – in the first year after merger

Johnes and Tsionas, 2018: inefficiency is negatively affected by tendency to merge and the action of merging. High heterogeneity of effect of merger on efficiency across different cases of mergers.

RESEARCH QUESTION

Do university mergers affect their efficiency (performance to resources ration)?

Possible channels:

1) **Economies of scale effect:**
   - -spread of administrative costs over larger output
   - -spread of faculty over larger number of students
   - -spread of fixed assets maintenance cost over larger output

2) **Economies of scope effect:**
   - -merger between universities with different missions (more efficient production of teaching and research jointly)
   - -development of interdisciplinary research after merger of universities with different specializations

3) **Quality of management**

METHODOLOGY STEP 1: PSM SAMPLE

Propensity score matching (PSM) is a technique allows homogenizing the sample and building relevant control group

Initial data:

447 public universities without branches

38 universities with “inefficient status” in 2013

14 universities that were consequently merged

Final data:

152 universities (matching 3:1)

PSM SAMPLE

	Before PSM		
	Treated	Non-treated	Whole sample
Average USE score (e1)	62.33 *(6.50)*	65.06 *(7.95)*	64.79 *(7.85)*
Total amount of R&D projects per faculty (e2)	172 *(178)*	210 *(361)*	206 *(347)*
Share of foreign students (e3)	3.34 *(3.47)*	4.36 *(5.16)*	4.26 *(5.02)*
Total income from all sources per faculty (e4)	1850 *(714)*	2048 *(1330)*	2029 *(1284)*
Total area of training and laboratory facilities per student (e5)	12.68 *(4.14)*	15.86 *(8.63)*	15.54 *(8.35)*
Employment of graduates (e6)	96.75 *(3.5)*	98.13 *(1.86)*	97.99 *(2.12)*
Faculty with PhD per 100 students (e7)	4.27 *(1.44)*	15.33 *(23.73)*	14.24 *(22.77)*

PSM SAMPLE

	After PSM		
	Treated	Control	Whole PSM sample
Average USE score	62.33 *(6.50)*	62.62 *(5.94)*	62.55 *(6.06)*
Total amount of R&D projects per faculty	172 *(178)*	185 *(473)*	181 *(419)*
Share of foreign students	3.34 *(3.47)*	2.79 *(3.11)*	2.93 *(3.2)*
Total income from all sources per faculty	1850 *(714)*	1856 *(918)*	1854 *(869)*
Total area of training and laboratory facilities per student	12.68 *(4.14)*	12.82 *(4.64)*	12.79 *(4.51)*
Employment of graduates	96.75 *(3.5)*	97.22 *(2.48)*	97.10 *(2.76)*
Faculty with PhD per 100 students	4.27 *(1.44)*	4.31 *(1.31)*	4.30 *(1.34)*

STEP 2: EFFICIENCY ESTIMATION

Bootstrapped DEA Estimator (Simar and Wilson, 2000)

INPUTS

OUTPUTS

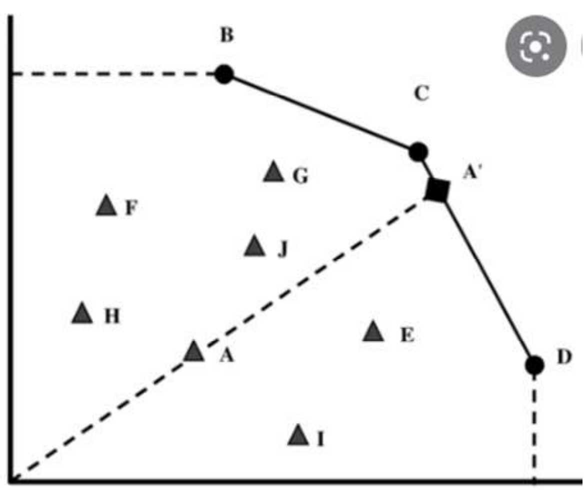
- ✓ Total income from all sources - x_1
- ✓ Total number of academic staff - x_2
- ✓ Average entrance exam score - x_3

- ✓ Number of publications in index journals per 100 of academic staff - y_1
- ✓ Total amount of R&D projects (in rubles) - y_2
- ✓ Total number of employed graduates- y_3

Robustness checks:

-SFA translog, SFA Cobb-Douglas, QR

-Additional inputs and outputs: total square of buildings used for teaching and research activities, share of faculty with advanced degrees, total volume of private R&D projects.

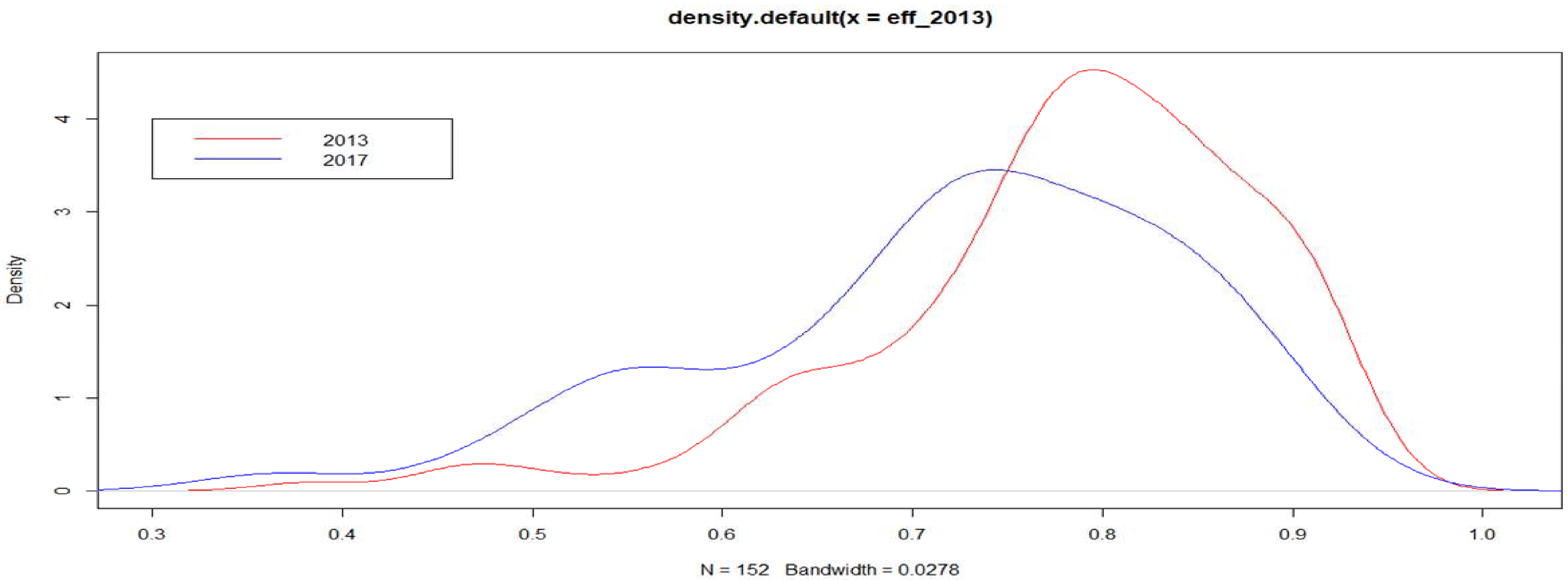


EFFICIENCY ESTIMATION

	2013 (Before treatment)			2017 (After treatment)			Change 2013-2017, %		
	Treated	Non-treated	Whole sample	Treated	Non-treated	Whole sample	Treated	Non-treated	Whole sample
Inputs									
Total income from all sources, ml. roubles	3 232 *(2 140)*	1 067 *(1 132)*	1 266 *(1 397)*	2 816 *(1 847)*	1 046 *(1 242)*	1 209 *(1 399)*	87.2	98.0	95.5
Average USE score	71.2 *(7.5)*	65.5 *(9.0)*	66.0 *(9.0)*	71.9 *(8.4)*	64.5 *(9.0)*	65.2 *(9.2)*	101.1	98.5	98.8
Total number of faculty	1208 *(502)*	518 *(387)*	581 *(445)*	1 001 *(359)*	425 *(357)*	478.8 *(393.4)*	82.9	82.3	82.4
Outputs									
Total number of publications	2 537 *(2 215)*	522 *(559)*	707 *(1024)*	4 193 *(3 158)*	1 733 *(1 862)*	1 960 *(2 124)*	165.3	331.9	277.2
Total number of graduates	12 908 *(4 670)*	5 452 *(3 895)*	6139 *(4508)*	12 804 *(5 065)*	4 928 *(4 384)*	5 653 *(4 627)*	99.2	90.4	92.1
Total amount of R&D projects, ml. roubles	487 *(488)*	108 *(198)*	142 *(261)*	657 *(679)*	129 *(273)*	178 *(362)*	134.7	120.0	124.5

EFFICIENCY ESTIMATION

	Treated	Non-treated	Whole sample
2013	0.829	0.777	0.781
	(0.054)	*(0.105)*	*(0.102)*
2017	0.797	0.714	0.722
	(0.064)	*(0.125)*	*(0.121)*
Change 2013-2017, %	96.1	91.9	92.5



METHODOLOGY STEP 3: FRDD

$$Y_i = \beta_0 + \beta_1 T_i + \beta_2 f(PS_i) + \beta X + \epsilon_i$$

$$T_i = \alpha_0 + \alpha_1 TA_i + \alpha_2 h(PS_i) + \alpha X + \vartheta_i$$

Y_i – an efficiency change of university i between 2013 and 2017;

T_i – a dummy variable representing that university was merged;

PS_i – a performance score of university i in 2013 (average ratio of observed value to threshold value);

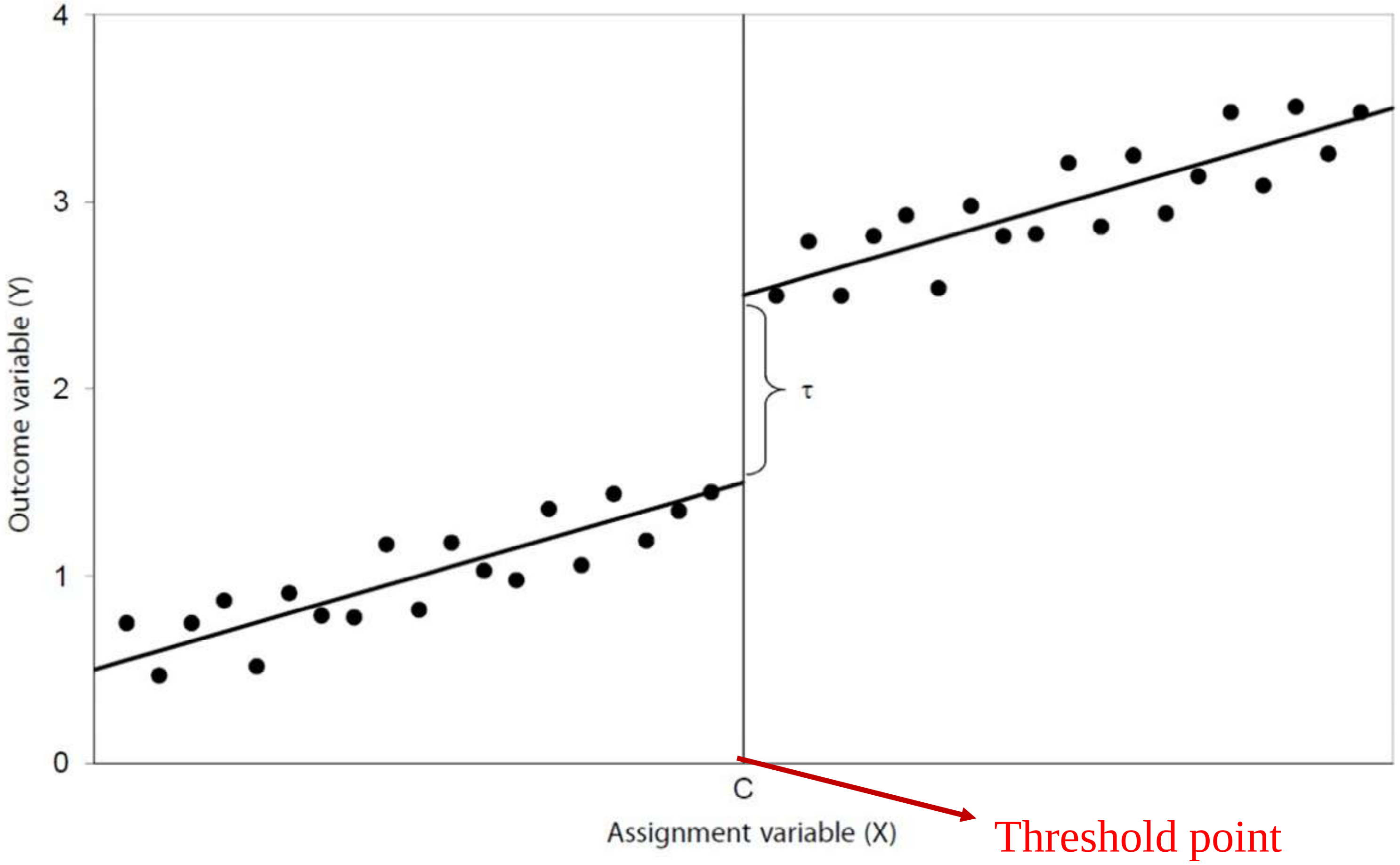
$f(.), h(.)$ – flexible functional forms;

X – the matrix of control variables (total number of students, average USE score, share of students in STEM fields);

ϵ_i, ϑ_i – random errors;

TA_i – a dummy variable reflecting university was assigned to the treatment;

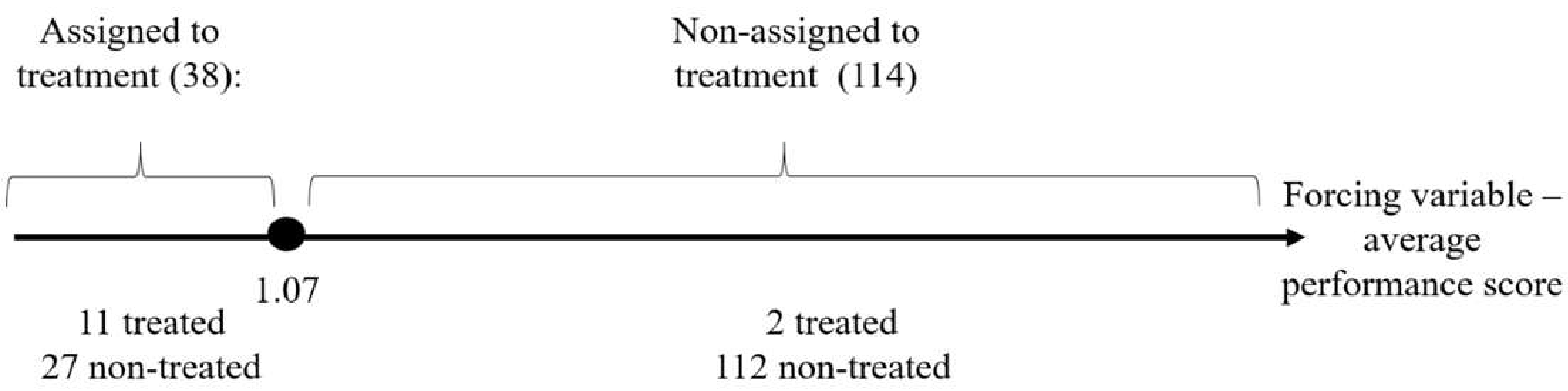
METHODOLOGY STEP 3: FRDD

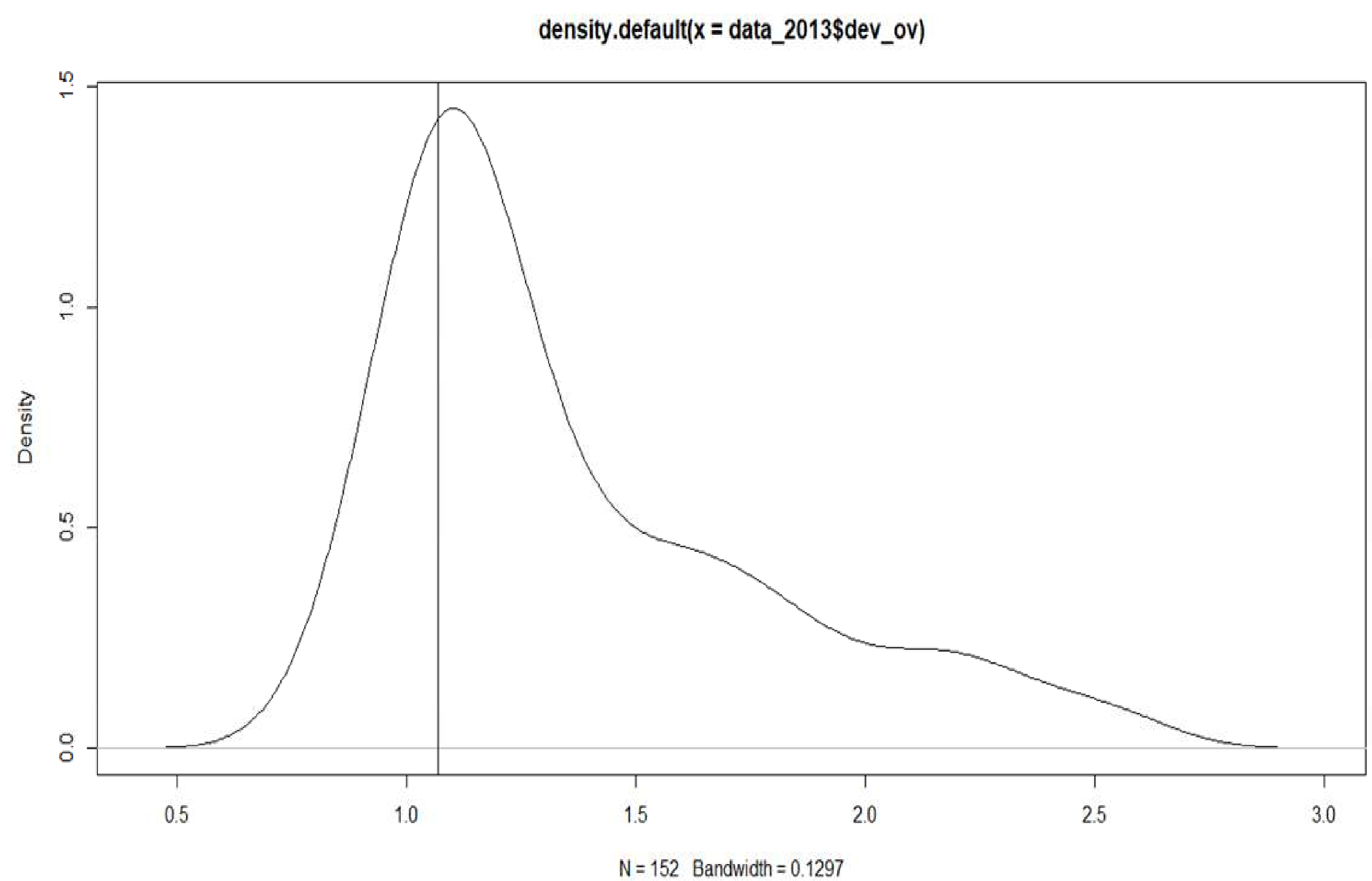


We regress outcome variable (efficiency gain) on the assignment variable (performance score). If we observe a gap in the regression line on the threshold, we observe the effect of the policy

STEP 3: FRDD

The structure of sample





FRDD

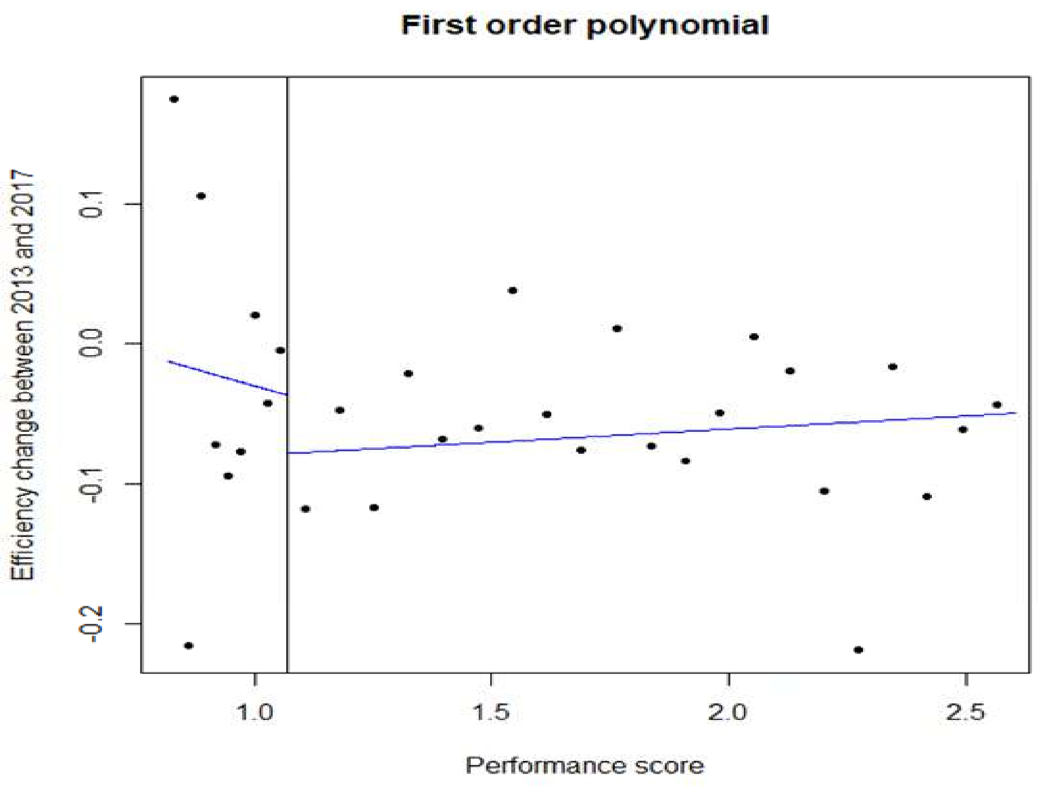
Descriptive statistics for control variables

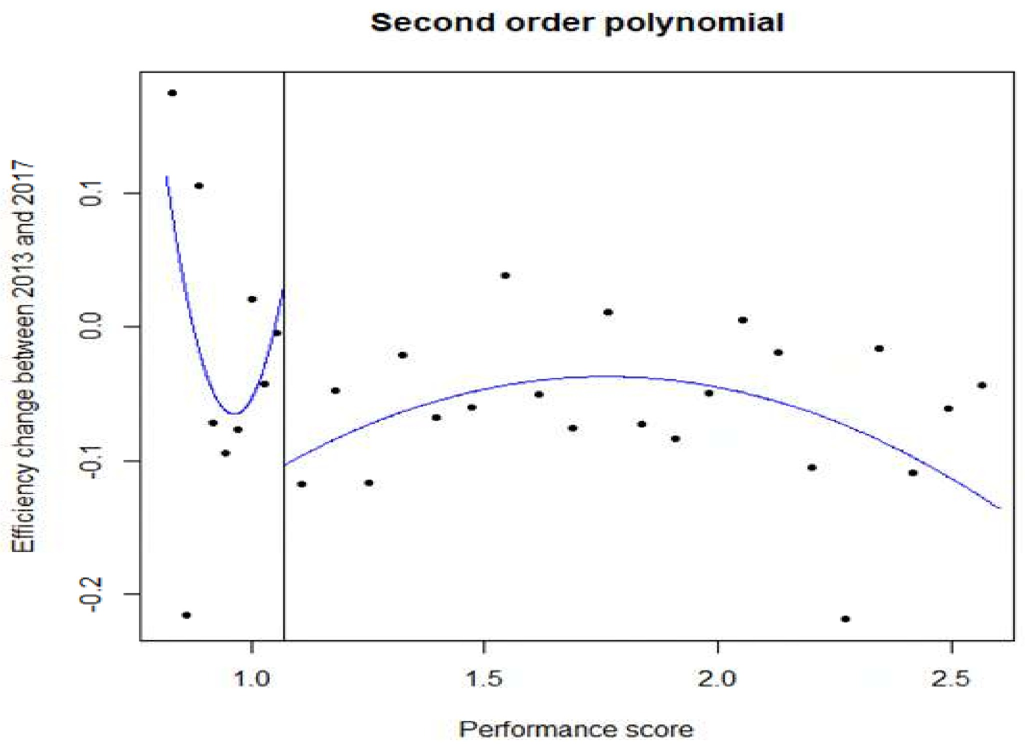
	2013 (Before treatment)			2017 (After treatment)			Change 2013-2017, %		
	Treated	Non-treated	Whole sample	Treated	Non-treated	Whole sample	Treated	Non-treated	Whole sample
Average USE score	72.1 *(7.0)*	65.5 *(9.0)*	66.1 *(9.0)*	73.1 *(7.7)*	64.5 *(9.0)*	65.3 *(9.2)*	101.4	98.5	98.8
Total number of students	13 179 *(4 745)*	5 455 *(3 882)*	6 115 *(4 501)*	13 147 *(5 101)*	4 922 *(3 970)*	5 626 *(4 669)*	99.8	90.2	92.0
Share of students in STEM fields	0.5 *(0.3)*	0.4 *(0.3)*	0.4 *(0.3)*	0.5 *(0.3)*	0.4 *(0.3)*	0.4 *(0.3)*	-	-	-

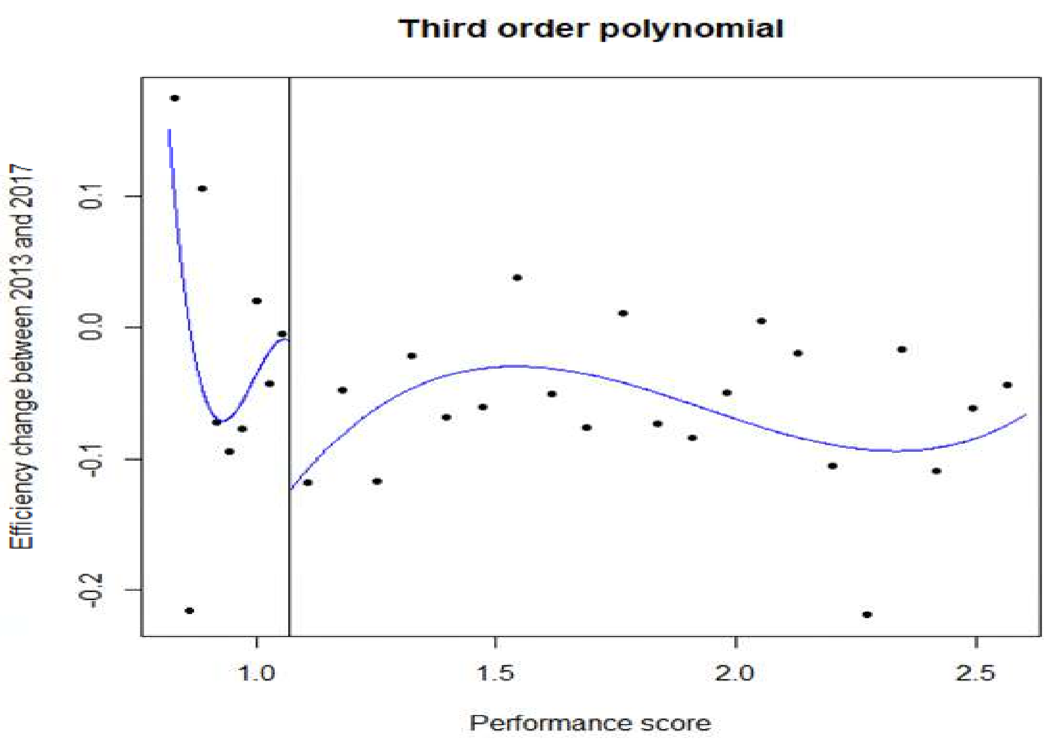
FRDD: RESULTS

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Parametric estimation (2SLS)							
Treatment effect	0.072	0.118	0.1142	0.157**	0.184*	0.137*	0.154*
(standard error)	*(0.063)*	*(0.074)*	(0.075)	*(0.059)*	*(0.071)*	*(0.065)*	*(0.075)*
Polynomial of performance score	First	First	First	Second	Second	Third	Third
Controls	No	Yes	Yes	No	Yes	No	Yes
Interactions	No	No	Yes	No	Yes	No	Yes
# of observations	152	152	152	152	152	152	152
Non-parametric estimation (local linear)							
Treatment effect	0.271*	0.313*	0.324*	0.275*	0.287*	0.173*	0.244*
(standard error)	*(0.106)*	*(0.124)*	*(0.146)*	*(0.113)*	*(0.141)*	*(0.081)*	*(0.127)*
Bandwidth	Optimal (0.195)	Optimal (0.195)	Optimal (0.195)	Optimal * 0.5 (0.097)	Optimal * 0.5 (0.097)	Optimal * 2 (0.391)	Optimal * 2 (0.391)
Controls	No	Yes	Yes	No	Yes	Yes	Yes
Interactions	No	No	Yes	No	Yes	Yes	Yes
# of observations	83	83	83	56	56	104	104

FRDD: RESULTS



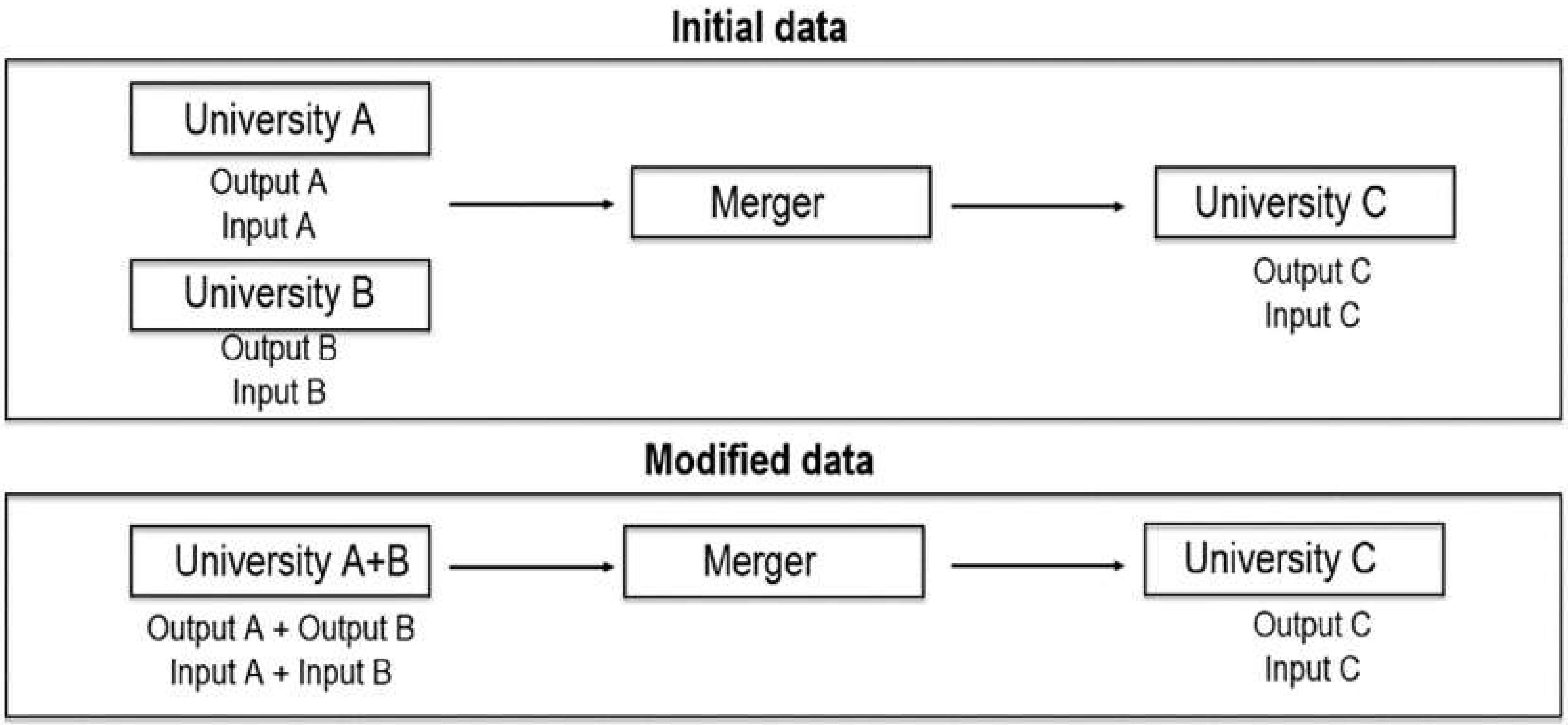




DISCUSSION

- Merged universities experienced greater efficiency gains (smaller efficiency declines) after the merger was implemented
- However, this effect can be identified just ner a cutoff point
- Possible channels through which merger process may influence efficiency: economies of scale effect, economies of scope effect, changes in managerial practices.
- The treatment effect identified using regression discontinuity design can be interpreted as a total influence of all possible factors.

EFFICIENCY ESTIMATION



STEP 3: FRDD – THRESHOLD IDENTIFICATION

Literature on structural breaks: (Card et al., 2008; Steinberg, 2014)

$$ineff_i = \beta_0 + \beta_1(Threshold_i) + \epsilon_i$$

where $ineff_i$ is a variable representing the "inefficient status" received by university i from the Ministry based on the Monitoring of Performance in 2013; $Threshold_i$ is an indicator function of the form:

$$Threshold_i = I\{APS_i < \theta\}$$

where APS_i is an aggregate performance score for university i; θ is the threshold value that we have to identify from our sample; I is an indicator function.

STEP 3: FRDD – THRESHOLD IDENTIFICATION

to achieve greater robustness we consider four alternative specifications:

$$ineff_i = \beta_0 + \beta_1(Threshold_i) + \beta_2(APS_i) + \epsilon_i$$

$$ineff_i = \beta_0 + \beta_1(Threshold_i) + \beta_2(APS_i) + \gamma X_i + \epsilon_i$$

$$ineff_i = \beta_0 + \beta_1(Threshold_i) + f(APS_i) + \epsilon_i$$

$$ineff_i = \beta_0 + \beta_1(Threshold_i) + f(APS_i) + \gamma X_i + \epsilon_i$$

where γX_i is the set of university's characteristics multiplied by the set of regression coefficients: total number of students on the university, average entrance exam score, share of students in STEM field; $f(.)$ is a second-order polynomial function; all other notations remain the same.

STEP 3: FRDD – THRESHOLD IDENTIFICATION

$$Threshold_i = I\{APS_i < \theta\}$$

Each equation we estimated 40 times with different values of θ, $\theta \in [0.8; 1.2]$

The highest R-squared corresponds to the θ=1.07 (in all equations)

Therefore, 1.07 is identified as a potential discontinuity point